



Particle Physics Division

Mechanical Department Engineering Note

Number: **MD-ENG-216**

Date: Nov. 18, 2009

Project: E-961, COUPP bubble chamber

Project Internal document database number: **Projects-doc-786-v1**

Title: COUPP 60 experiment, environmental heat load estimate

Author(s): Russ Rucinski

Reviewer(s): Andrew Sonnenschein, Erik Ramberg

Key Words: COUPP, tunnel, heat, infrastructure, SNOLAB, MINOS

Abstract/Summary:

The heat load from COUPP 60, E-961 is estimated. This heat load will be imposed on the environmental cooling system of a future underground site such as the MINOS underground site or SNOLAB.

Applicable Codes:

The estimated steady state heat load from the COUPP 60 kg, experiment to the tunnel surroundings is 2700 watts.

Item	Heat load
Hot water tank	470 watts
Water pump	800 watts
Camera air cooling	280 watts
PLC & controls	250 watts
Sola transformer	400 watts
DAQ & PMT	500 watts
<b>Total</b>	<b>2700 watts</b>

Details for each item are presented below.

**1.) Hot water tank, 470 watts.**

There is a double walled polyethylene plastic water tank with 2" of foam insulation between the inner wall and outer wall. The plastic walls of the inner and outer tank are 0.5" thick. The inner tank will hold about 10 feet of water that may be up to 40 C in temperature. The overall size of the outer tank is 8.5 feet diameter x 12.5 feet high.

**2.) Water recirculation pump, 800 watts on low speed.**

There is a water recirculation pump used to recirculate water from the tank through an in-line heater, filter and then back to the tank. The motor is four horsepower. It has a high and low speed. High speed draws about 12 amps at 240 volts. Low speed draws 3.5 amps. We operate on low speed. I am assuming low speed is the equivalent of 1.2 horsepower which can be estimated to give off 800 watts of heat.

**3.) Camera cooling, 280 watts.**

We blow air through a submerged PVC pipe system onto the cameras. The return air heats up from the camera power and the hot water bath. The air rejected to the tunnel is estimated to be at a temperature of 31 C. The air flow rate is 44 cfm, generated by a small blower.

**4.) PLC and instrumentation, 250 watts.**

This is a pretty good number.

**5.) Sola transformer, 400 watts**

This is a rough guess. The transformer is hot to the touch, probably 40 C and has a surface area of about 2 m<sup>2</sup>. We may not need to use this particular transformer underground. Perhaps suitable power already exists at the underground site.

**6.) DAQ and PMT rack equipment, 500 watts.**

I note that the UPS that serves this equipment and the PLC and instrumentation has a capacity of 700 watts.

**7.) Chiller, 1900 watts (only used for filling, first day or two of operations)**

This item isn't included in the steady state heat load since it is only used at start up.